Notice of Allowability	Application No.	Applicant(s)	
	10/657,943	KUSUNOKI, RYUTARO	
	Examiner	Art Unit	
	Geoffrey Mruk	2853	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *21 January 2004*.

2. ☒ The allowed claim(s) is/are *1-4*.

3. ☒ The drawings filed on *21 January 2004* are accepted by the Examiner.

4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☒ All b) ☐ Some* c) ☐ None of the:
      1. ☒ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 9/9/03, 7/27/04
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

MANISH S. SHAH
PRIMARY EXAMINER

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Replace the Abstract as below.

-- The inkjet recording apparatus having ink, where the inertia of ink in a flow passage is M, a viscosity resistance of the ink in the flow passage is R, and a return force of a meniscus is K in a nozzle, when the ink is charged in the flow passage composed of a nozzle and a pressure generating chamber, the physical properties of the ink and the shape of the flow passage are set such that a relationship of $0.2 \leq \gamma^2/\omega^2 \leq 1.0$ is satisfied, where $\omega = \sqrt{K/M}$ and $\gamma = R/2M$. --

Authorization for this examiner's amendment was given in a telephone interview with Gregory Schivley on 8 March 2005.

The application has been amended as follows:

Replace claim 1 as below.

-- 1. An inkjet head comprising:

a plurality of flow passages each composed of a nozzle to discharge ink and a pressure generating chamber communicating to the nozzle;

a common ink chamber which supplies ink to each of the flow passages; and

an actuator which expands/contracts a volume of the pressure generating chamber,

wherein the physical properties of the ink and one of said plurality of flow passages satisfy a relationship of $0.2 \leq \gamma^2/\omega^2 \leq 1.0$, wherein $\gamma = R/2M$, $\omega = \sqrt{K/M}$, where M is inertia of the ink in the flow passages when the ink is charged in the flow passage, R is a viscosity resistance of the ink in the flow passages, and K is the return force of the meniscus. --

Replace claim 3 as below.

-- 3. An inkjet recording apparatus comprising:

a plurality of flow passages each composed of a nozzle to discharge ink and a pressure generating chamber communicating to the nozzle;

a common ink chamber which supplies ink to each of the flow passages;

an actuator which expands/contracts a volume of the pressure generating chamber; and

a drive signal generating portion which outputs a drive signal for continuously discharging a plurality of ink drops from the nozzle to the actuator,

wherein the physical properties of the ink and one of said plurality of flow passages satisfy a relationship of $0.2 \leq \gamma^2/\omega^2 \leq 1.0$, wherein $\gamma = R/2M$, $\omega = \sqrt{K/M}$, where M is inertia of the ink in the flow passages when the ink is charged in the flow passage, R is a viscosity resistance of the ink in the flow passages, and K is the return force of the meniscus. --

Replace claim 4 as below.

-- 4. An inkjet recording apparatus comprising:

a plurality of flow passages each composed of a nozzle to discharge ink and a pressure generating chamber communicating to the nozzle;

a common ink chamber which supplies ink to each of the flow passages;

a fluid resistor provided between the pressure generating chamber of the flow passage and the common ink chamber;

an actuator which expands/contracts a volume of the pressure generating chamber; and

a drive signal generating portion which outputs a drive signal for continuously discharging a plurality of ink drops from the nozzle to the actuator,

wherein the physical properties of the ink and one of said plurality of flow passages satisfy a relationship of $0.2 \leq \gamma^2/\omega^2$

≤ 1.0, wherein $\gamma = R/2M$, $\omega = \sqrt{K/M}$, where M is inertia of the ink in the flow passages when the ink is charged in the flow passage, and R is a viscosity resistance of the ink in the flow passages, and K is the return force of the meniscus. --

The following is an examiner's statement of reasons for allowance:

The primary reason for the allowance of claims 1-4 is the applicant's claimed invention includes an inkjet print head apparatus in which a meniscus return force (K) is used as a parameter for optimizing the ink inertia (M) and the ink viscosity resistance (R) so that a relationship ($0.2 \leq \gamma^2/\omega^2 \leq 1.0$), where $\gamma = R/2M$, $\omega = \sqrt{K/M}$, between the physical properties of the ink and the flow passage is satisfied. This relationship permits a stable ink discharge operation and an increased drive frequency of the inkjet print head. It is this limitation, expressed in the claimed combination not found, taught, or suggested that makes these claims allowable over the prior art.

United States patent number 6,412,926 B1 to Okuda, teach an inkjet print head where the configurations of a nozzle, an ink supply aperture, and a pressure generating chamber are set so that the inertance (m_T) and the acoustic resistance (r_T) of the print head satisfy expressions $0<m_T<1.9\times10^8$ [kg/m^4] and $4.0\times10^{12}<r_T<11.0\times10^{12}$ [Ns/m^5]. These expressions allow the inkjet print head to discharge at a frequency of 10kHz or more (Column 8, lines 48-62).

United States patent number 6,382,754 B1 to Morikoshi et al., teach an inkjet printing device which is driven according to dimensions of the ink flow channels,

physical properties of the material and ink, and environmental temperature (Column 3, lines 26-30). Thus, "the flying speed of ink drops is stabilized as the ink drops are discharged in such a state that the meniscus is made to stand still at the predetermined position, irrespective of the repetition of frequency, by suddenly bringing the meniscus to a standstill. Further, the shortened recovery time of the meniscus makes the response frequency improvable" (Column 24, lines 6-10).

United States patent number 5,754,204 to Kitahara, teach an inkjet recording head in which "the inertance of the nozzle opening (Mn) and the inertance of the ink supply port (Ms) are optimized, the printing quality can be further improved" (Column 5, lines 31-31).

United States patent number 4,625,221 to Mizuno et al., teach an inkjet recording head where "Unnecessary resonance at the orifice can be suppressed by appropriately selecting the viscosity of the ink and the frequency characteristic of the pulse signal. By this means, it is possible to prevent unnecessary satellite particles from being generated around each droplet of ink" (Column 6, lines 28-33).

United States patent number 4,024,544 to Vernon, teach an inkjet recording head where "the purpose of the instant invention to dampen the meniscus vibration amplitude and thereby decrease the time of meniscus stabilization resulting in increasing the ink droplet expression frequency and also prevent the ingestion of air into the system. This is accomplished in one manner by the provision of a second pressure chamber" (Column 2, lines 62-67).

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Geoffrey Mruk whose telephone number is (571) 272-2810. The examiner can normally be reached on 7am - 330pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

GSM
3/10/2005

GM

MANISH S. SHAH
PRIMARY EXAMINER